



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/824,719	04/15/2004	Pcter J. Schubert	89190.130903/DP-311079	6710

7590 11/21/2007  
Jimmy L. Funke, Esq.  
Delphi Technologies, Inc.  
Mail Code 480410202  
P.O. Box 5052  
Troy, MI 48007

EXAMINER
----------

CHUO, TONY SHENG HSIANG

ART UNIT	PAPER NUMBER
----------	--------------

1795

MAIL DATE	DELIVERY MODE
-----------	---------------

11/21/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/824,719	<b>Applicant(s)</b> SCHUBERT ET AL.	
	<b>Examiner</b> Tony Chuo	<b>Art Unit</b> 1795	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 01 October 2007.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 October 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Claims 1-24 are currently pending. Claims 25-37 have been cancelled. The previous objection to the drawings is withdrawn. The previous 112 rejection of claims 20 and 24 is withdrawn. The amended claims do overcome the previously stated 102 and 103 rejections. However, upon further consideration, claims 1-24 are rejected under the following new 102 and 103 rejections. This action is made FINAL as necessitated by the amendment.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 2, 4, 5, 15, and 19-22 are rejected under 35 U.S.C. 102(b) as being anticipated by Northrup et al (US 5882496).

Regarding claims 1, 2, 5, 19, 20, and 21, the Northrup reference discloses a porous silicon structure that is formed by etching a crystalline silicon substrate or wafer "23" to form interior surfaces "11" (See column 3, lines 43-46 and Figure 1). It also discloses that the porous silicon structures are useful in significantly augmenting the adsorption and desorption of gases (See Abstract).

Examiner's note: The recitations "for storing and retrieving elemental hydrogen" and "hydrogen storage member" have not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

In addition, it is inherent that the etching of the silicon wafer forms etched pits that have interior surfaces that are adapted to adsorb and store hydrogen.

Further, it is also inherent that the porous silicon wafer defines a surface layer over at least a first surface portion of the porous silicon wafer.

Finally, it is well known in the art that crystalline silicon wafers can be formed in a monocrystalline form or a polycrystalline form.

Regarding claim 4, it also discloses a plurality of spaced porous silicon member "68" (See column 7, line 31 and Figure 7B).

Regarding claim 15, the "means for" language is construed as invoking 35 USC 112, sixth paragraph. The heater "28" taught by Northrup et al is an equivalent structure for releasing the stored gas from the porous silicon structure (See column 4, lines 51-52).

Regarding claim 22, it also discloses treating the crystalline silicon substrate by wet etching the substrate with a hydrogen fluoride solution (See column 3, line 64).

***Claim Rejections - 35 USC § 102/103***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 23, and 24 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Northrup et al (US 5882496).

The Northrup reference discloses a porous silicon structure that is formed by etching a crystalline silicon substrate or wafer "23" to form interior surfaces "11" (See column 3, lines 43-46 and Figure 1).

Examiner's note: It is noted that claims 23 and 24 are being construed as product-by-process and that the product itself does not depend on the process of making it. Accordingly, in a product-by-process claim, the patentability of a product does not depend on its method of production. In that, it is further noted that the product in the instant claim is the same as or obvious over the product of the prior art.

Therefore, the claim is anticipated by Northrup et al. However, if the claim is not anticipated, the claim is obvious as it has been held similar products claimed in product-by-process limitations are obvious (In re Brown 173 USPQ 685 and In re Fessman 180 USPQ 324, See MPEP 2113: Product-by-Process claims).

7. Claims 8, 10, and 11 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kornilovich (US 2004/0209144).

The Kornilovich reference discloses a fuel cartridge holding a gas storage medium comprising multiple silicon nanowires (silicon columns) that has enough porosity to allow fast diffusion of gas molecules, especially for hydrogen, wherein the surface of the silicon nanowires are used to physisorb gas molecules such as neutral hydrogen molecules (See paragraph [0013],[0017],[0018]). It also discloses that the gas molecules may be released by the application of heat (See paragraph [0016]).

Examiner's note: It is noted that claims 10 and 11 are being construed as product-by-process and that the product itself does not depend on the process of making it. Accordingly, in a product-by-process claim, the patentability of a product does not depend on its method of production. In that, it is further noted that the product in the instant claim is the same as or obvious over the product of the prior art.

Therefore, the claim is anticipated by Kornilovich. However, if the claim is not anticipated, the claim is obvious as it has been held similar products claimed in product-by-process limitations are obvious (In re Brown 173 USPQ 685 and In re Fessman 180 USPQ 324, See MPEP 2113: Product-by-Process claims).

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Northrup et al (US 5882496) in view of Winstel (US 4265720). The Northrup reference is applied to claim 1 for reasons stated above.

However, Northrup et al does not expressly teach a housing for enclosing the hydrogen storage member; and a control system for regulating storage of hydrogen into and retrieval of hydrogen from the storage member. The Winstel reference discloses a container "4" enclosing storage bodies "5" and a valve control means "6" for charging and discharging hydrogen (See column 3, lines 40-48).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Northrup porous silicon structures to include a housing for enclosing the hydrogen storage member; and a control system for regulating storage of hydrogen into and retrieval of hydrogen from the storage member in order to utilize a storage device that efficiently controls the charging and discharging of hydrogen.

10. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Northrup et al (US 5882496). The Northrup reference is applied to claims 1 and 5 for reasons stated above.

However, Northrup et al does not expressly teach a percent void volume of the surface layer that is about 50%. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Northrup porous silicon structures to include a percent void volume of the surface layer that is about 50% because it has been held that the discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. *In re Boesch*, 205 USPQ 215 (CCPA 1980). The percent void volume is a result effective variable of increasing the surface area of the porous silicon structure. In addition, there is no evidence of the criticality of the percent void volume.

11. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Northrup et al (US 5882496) in view of Wagner et al (US 5196377). The Northrup reference is applied to claim 6 for reasons stated above.

However, Northrup et al does not expressly teach electronic integrated circuits on a second surface portion of the hydrogen storage member. The Wagner reference discloses integrated circuits that are placed inside cavities of a silicon wafer "10" (See column 11, lines 12-16).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Northrup porous silicon structures to include electronic integrated circuits on a second surface portion of the hydrogen storage member in order to utilize well known integrated circuit processing techniques to provide a silicon water-based integrated circuit carrier offering high density packaging with high yield processes. In addition, one skilled in the art could have combined the elements as



claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art at the time of the invention.

12. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kornilovich (US 2004/0209144). The Kornilovich reference is applied to claim 8 for reasons stated above. In addition, Kornilovich discloses that the storage efficiency of the described medium improves with decreasing nanowire radius and increasing nanowire length (See column 3, lines 31-33).

However, Kornilovich does not expressly teach silicon columns that have an aspect ratio of length to diameter of at least 10. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Kornilovich gas storage medium to include silicon columns that have an aspect ratio of length to diameter of at least 10 because changes of proportions was held to be obvious (*In re Feilds* 134 USPQ 242 (CCPA 1962)). In addition, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the gas storage medium to include silicon columns that have an aspect ratio of length to diameter of at least 10 in order to improve the storage efficiency of the gas storage medium.

13. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kornilovich (US 2004/0209144) in view of Majumdar et al (US 2002/0172820). The Kornilovich reference is applied to claim 8 for reasons stated above. In addition,

Kornilovich discloses nanowires that have a diameter of less than about one micrometer and may include cylindrical structures (See column 1, lines 56-60).

However, Kornilovich does not expressly teach silicon columns that have diameters of about 1 nm. The Majumdar reference discloses methods of forming nanowire structures with a diameter of approximately 5 nm to approximately 50 nm (See paragraph [0068]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Kornilovich gas storage medium to include silicon columns that have diameters of about 1 nm in order to improve the storage efficiency of the gas storage medium by increasing the surface area of the silicon columns. In addition, if the range of the prior art and claimed range do not overlap, obviousness may still exist if the ranges are close enough that one would not expect a difference in properties (*In re Woodruff* 16 USPQ 2d 1934 (Fed. Cir. 1990)).

14. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kornilovich (US 2004/0209144) in view of Anthony et al (US 6040230). The Kornilovich reference is applied to claim 10 for reasons stated above.

However, Kornilovich does not expressly teach silicon columns that have roughened surface. The Anthony reference discloses polysilicon structures "306" that etched with oxygen in order to roughen the surface (See column 6, lines 6-10).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Kornilovich gas storage medium to include

silicon columns that have roughened surface in order to enhance the surface area of the silicon columns and improve the storage efficiency.

15. Claims 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Northrup et al (US 5882496) in view of Meinzer (US 5360461). The Northrup reference is applied to claims 1 and 15 for reasons stated above.

However, Northrup et al does not expressly teach releasing means that is selected from the group consisting of light sources, current sources, voltage sources, and combinations thereof, wherein the releasing means comprises a light emitting diode. The Meinzer reference discloses releasing hydrogen from a hydrogen storage bed optically by transmitting photons by any known means such as direct illumination by a light source "18", wherein light sources may be laser diodes (See column 5, lines 21-27).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the Northrup method of releasing hydrogen with a releasing means that is a light source, wherein the releasing means comprises a light emitting diode because the substitution of one known method for another would have yielded predictable results to one of ordinary skill in the art at the time of the invention.

16. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Northrup et al (US 5882496) in view of Meinzer (US 5360461). The Northrup reference is applied to claims 1 and 15 for reasons stated above.

However, Northrup et al does not expressly teach releasing means that comprises a light source. The Meinzer reference discloses releasing hydrogen from a hydrogen storage bed optically by transmitting photons by any known means such as direct illumination by a light source "18", wherein light sources may be laser diodes (See column 5, lines 21-27).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the Northrup method of releasing hydrogen with a releasing means that is a light source because the substitution of one known method for another would have yielded predictable results to one of ordinary skill in the art at the time of the invention.

However, Northrup as modified by Meinzer does not expressly teach a light source that emits photon energy at a wavelength of about 660 nanometers. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a light source that emits photon energy at a wavelength of about 660 nanometers as a means for releasing stored hydrogen because there are a finite number of predictable potential solutions to the recognized problem of releasing hydrogen by using a light source and one skilled in the art could have pursued the known potential solutions with a reasonable expectation of success.

### ***Response to Arguments***

17. Applicant's arguments with respect to claims 1-24 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Chuo whose telephone number is (571) 272-0717. The examiner can normally be reached on M-F, 7:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR.

Application/Control Number:  
10/824,719  
Art Unit: 1795

Page 13

Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TC

  
JONATHAN CREPEAU  
PRIMARY EXAMINER